

Archaeoacoustics Analysis and Ceremonial Customs in an Ancient Hypogeum

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Abstract

The archaeoacoustic properties and the historical rituals of two ancient underground hypogea were compared. The first in Malta is more widely known and researched; the second in Italy has been studied by SB Research Group (SBRG) and presents some similarities to the Maltese hypogeum. The results show that archaeoacoustics is an interesting new method for reanalyzing ancient sites, and it uses different study parameters to re-discover forgotten technology which operates on the human emotional sphere. The effect on the psyche of ancient people through the acoustic proprieties suggests that the builders of these sites had knowledge of this process and probably used it to enhance their rituals.

Keywords

Archaeoacoustics, infrasounds, low frequencies, Malta, Cividale del Friuli, hypogeum

The phenomenon of resonance is something that has been known for many centuries. It is often misunderstood and sometimes confused with episodes of mystical philosophy. Traces of it are found in ancient writings and oral traditions, and also in ancient artefacts and prehistoric architecture (Mortenson 2011). Today it is a recognized phenomenon and used in many modern technologies by physicists. Without going too deeply into complex physical mechanisms, resonance is the phenomenon in which an object absorbs energy, transforms it and makes it into another energy form which has been enhanced, an acoustic guitar is one such example.

SB Research Group (SBRG)¹ have conducted research in different European countries on this theme for three years at several underground structures and with some similarities discovered amongst them. Is it possible that this technology was well-known by ancient people who used it in their rites thousands of years before Christ? What was the impact of their technology on human perception? Following on from

the findings of other researchers (Princeton Engineering Anomalies Research—PEAR, from University of Princeton; see Jahn, Devereux, and Ibison 1995), SBRG experiments at ancient sites in Europe (Italy, Bosnia-Herzegovina) (Debertolis and Savolainen 2012; Debertolis and Bisconti 2013) have confirmed their hypothesis. This is suggestive of the idea that through the resonance phenomenon, the ancient population was able to influence the perception of the human body to obtain different states of consciousness without the use of drugs or other chemical substances. This mystery is along away from being resolved, however the technology hidden in these temples underneath apparently crude

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architecture suggests that builders used their knowledge of this physical phenomenon thousands of years before modern day technology. SBRG is beginning a new study in collaboration with the Otorhinolaryngology Clinic and the Neurophysiology Service of Trieste for the assessment of the effects of resonance phenomena on the human body. Volunteers will undergo examination by electroencephalogram (EEG) while listening to tones between 90Hz and 120Hz, similar to the resonant sounds present in some Neolithic structures in Europe (England, Ireland, Italy, and Malta).

In this paper, the comparison between a well-known hypogeum in Malta (Hal Salfieni) and another one in Italy (Cividale del Friuli hypogeum) is presented, the technology used by their builders appears to be very similar even though they are very different in terms of size.

THE MALTESE TEMPLES AND THE HYPOGEUM OF HAL SAFLIENI

The Maltese archipelago is made up of two main islands: Malta and Gozo. Among them there are two small islands, Comino and Cominotto, on the South there is a small rock called Filfla. According to academic archaeology, the first time man arrived on the island was in 5200 BC. Through archaeological excavations and the use of carbon 14 dating, the construction of megalithic complexes was placed at around 3600 BC (Trump 1981). Many researchers have tried to analyze and study the architecture of the Maltese temples, the most widely known were: Zammit, Ugolini, Ceschi and the British archaeologists Trump and Evans.

The Maltese temples are the most perfect architectural expression of Mediterranean civilizations, and appear far superior to other similar structures in the lands bordering the Mediterranean. The “nuraghi” of Sardinia, the “sesi” of Pantelleria Island, and the “talayots” of Balearic Islands are architecturally far

less important than the Maltese temples (Ceschi 1939).

The architecture of Maltese culture has from the earliest stages developed into two different styles: Epigeous and Chthonic. The first is probably connected to “religious” ceremonies, but the kind where a connection was made to the divine; it is not possible to say how these were performed with any certainty.

The better known temple sites have anything between one to four temples, which are often interconnected to form unique architectural structures. These were probably made in stages, through a process of continuous change and transformation.

Sometimes structures of different types were added to the temples such as altars, external trilithons and megalithic enclosures. In most cases these areas appeared to be the main centre of worship, as the enclosed area suggests that they formed “nucleus of worship” (Recchia 2006).

The architectural structures of these megalithic temples have common characteristics between them but there are also a number of different solutions employed between each site. The recurring elements are the large D shape outer perimeter wall and facade to exedra, with a curtain of orthostatic blocks arranged horizontally above a base constructed from vertical blocks with a large basement step present. The front opening is a trilithic structure that leads into a hallway or a central courtyard. On the sides there are interior compartments which are sometimes elliptical or semi-circular.

Among these megalithic complexes, the Ggantija temples, located on the island of Gozo, should be cited. The name was devised in the Middle Age and means “tower of the Giants”; dating suggests that they were built around 3600-2500 BC. These massive structures have a four-leaf clover shape, consisting of coral limestone cyclopean stones, some of which are up to 5 meters long, weighing up to 50 tons. Both temples have a series of semicircular apses connected by a hall

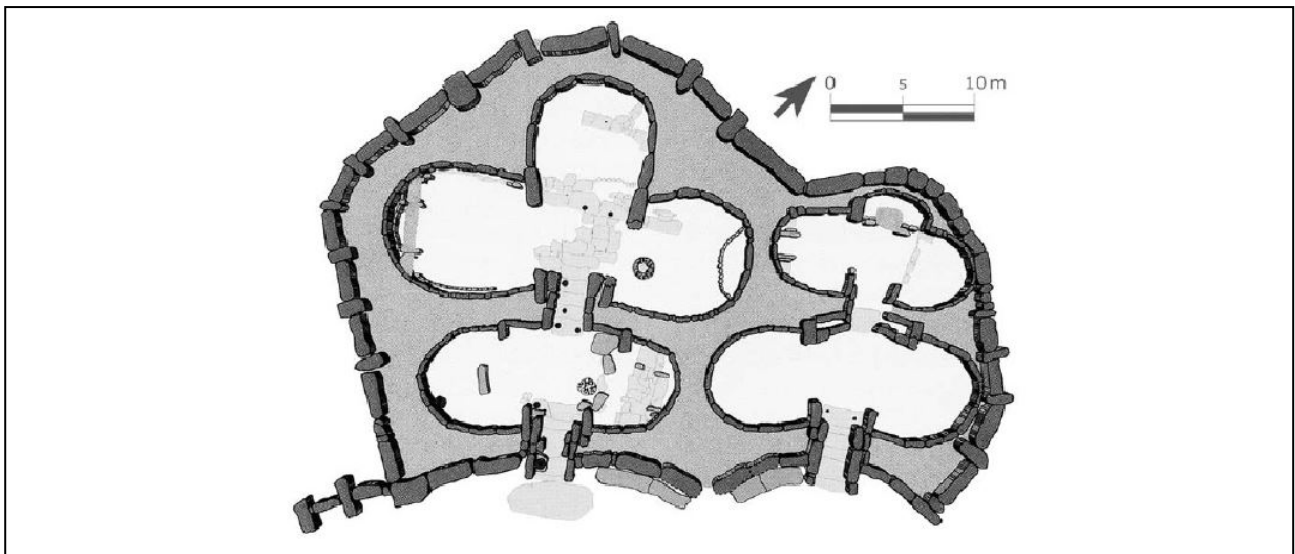


Figure 1. Plan of Ggantija Temple.

in the center, according to legend these two megalithic complexes were built by a race of giants that lived on the island in ancient times (see Figure 1).

A similar shape is present in Hal Saflieni hypogeum, an underground complex dug into the rock. This is a United Nations Educational, Scientific and Cultural Organization (UNESCO) heritage site (together with Ggantija, Hagar Qim, Menaidra, Scorba, Ta Hagraat Tarxien) and was accidentally discovered in 1902 during construction work. The complex consists of a system of chambers and passages that develops into three distinct underground levels until reaching a maximum depth of about 11 meters and covering an area of about 500 km².

At the first glance, this immense work seems to be the result of a well organized and advanced civilization. It seems difficult to believe that the rock has been excavated using only simple tools made of bone or hard stone. The architecture of this hypogeum features a curved shape such as an apsis cellae of the surface temples. Inside, it is remarkable to see the rock excavations of the chambers which would have allowed other more spontaneous and rational solutions, full of arches, vaults and domes, and more primitive

rigid masses with two vertical stones and one horizontally placed on top (Ceschi 1939) (see Figure 2).

The Maltese hypogeum played two roles, the first as a sanctuary dedicated to the worship of the Mother Goddess, the second as a burial place, as evidenced by the remains of thousands of skeletons with their ornaments and their pottery.

It has been hypothesized that the holes in the ground in front of the entrance could have been used to collect the libation of animals destined for sacrifice, or for solid offerings with rope being run through the holes (Evans 1971).

The holes in the walls of the interconnecting chambers are attributable to the practice of the oracles; it is plausible that a priest took advantage of the echo phenomenon and resonance, answering anonymously any questions that were asked. The most interesting example, attributed to this fascinating practice, is the one that inside the Hypogeum, speaking from a niche carved inside a room, the voice is greatly amplified and deepened.

These chambers may have served as centres for social or spiritual events, so the resonance of the

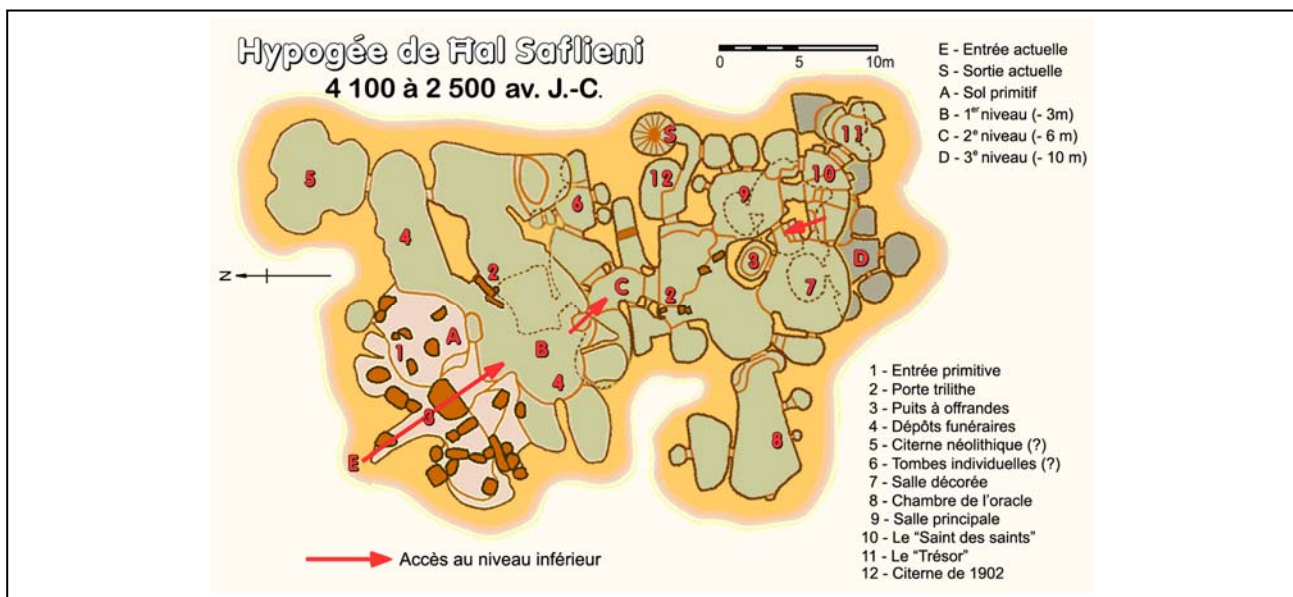


Figure 2. Map of the Maltese Hypogeum Hal Saflieni.

chamber cavities might have been intended to support human ritual chanting and mystic consciousness.

In this context archaeoacoustic studies were carried in this underground structure in recent years by the Maltese Old Temples Study Foundation (OTSF): many of these chambers have a resonance frequency of between 95Hz and 120Hz, especially close to 110Hz, using a well-known system of rock carving to tune the chambers to this low frequency range.

THE CIVIDALE DEL FRIULI HYPOGEUM, ITALY

This consists of various underground spaces below the surface, with different levels and branches that have been carved out of the conglomerate. Its shape looks very rough to a careless eye, but in reality despite the alterations over the centuries, the builders made full use of the shape of the rooms to take advantage of the resonance phenomenon, obtained during prayers and mystic songs (see Figure 3).

The underground could have been derived from a natural cavity along the right rocky riverbank of the

Natisone river. Aside from the fanciful interpretations mixed with legends, it was hypothesized that during the Celtic age, the Hypogeum was used as a depository for funerary urns, however other researchers believed that it was used as a prison during the Roman or Lombard period.

There are three big and disturbing masks carved on its walls in the style of the Celtic tradition, similar to the remains of sculptures found in Celtic graves in France known as *têtes coupées*. There are also niches carved by different builders which are perfectly dry, they could have been used as a mortuary at a later date. In respect of the other chambers they are wet so would have been unsuitable for use as a mortuary.

It is assumed that some of the hypogeum's rooms functioned as water tanks used for some sorts of ceremonial rites of uncertain origin. However, the true function and origin of this underground structure, unique in Friuli, remains a historic mystery. It is certain that the underground has been remodeled over successive periods, however none of the other hypotheses have been supported by evidence.

The structure is represented by a central tall

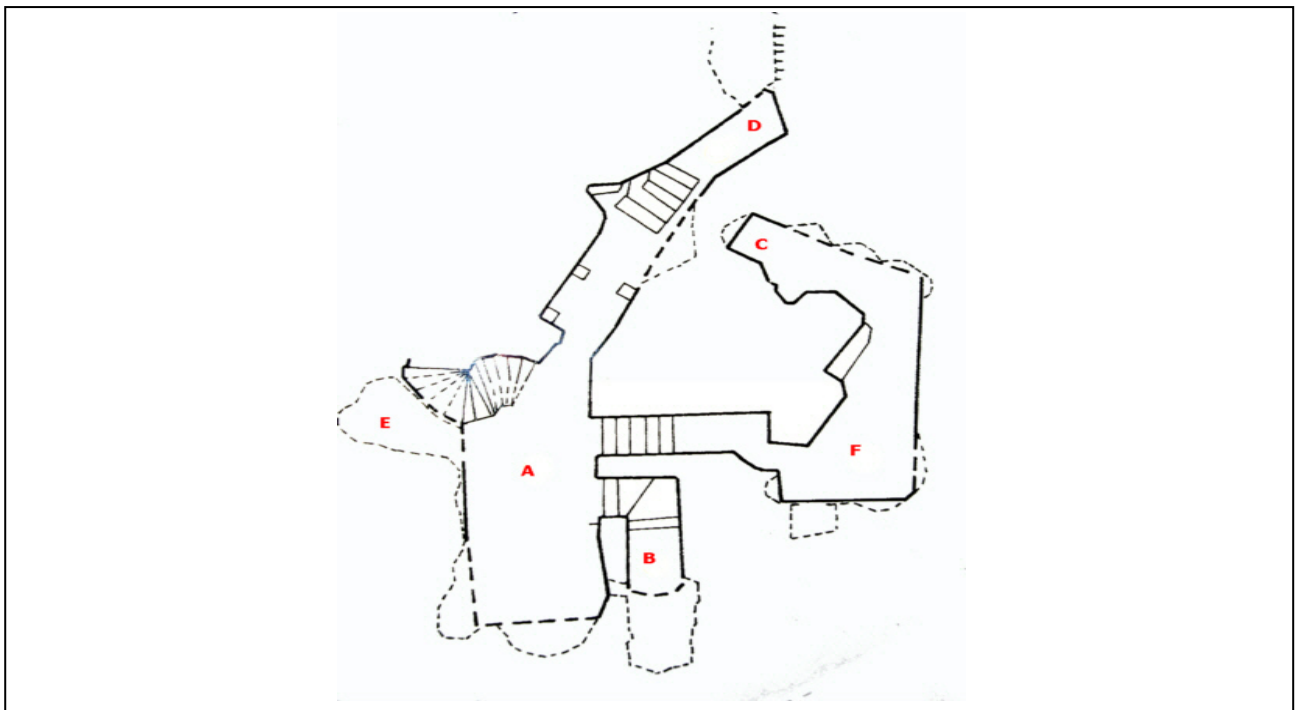


Figure 3. Map of the Hypogeum of Cividale del Friuli.

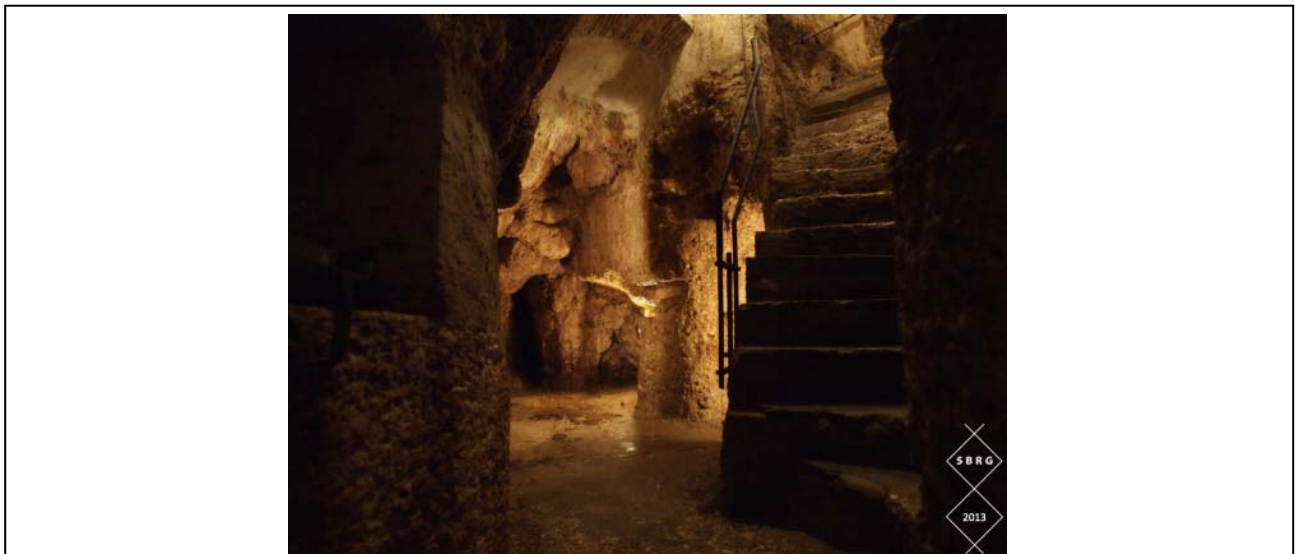


Figure 4. The Stairs Leading to the Central Room (Chamber A of the Map).

chamber that is reached from the surface through steep descending steps (see Figure 4). At the beginning of these steps, you can find the only window that gives access to the riverbank of the Natisone, the rest of the structure is completely underground. Three corridors

lead off from the central chamber and contain niches and seats of various heights. Many niches appear to have been dug with a pick and refer to later periods.

SBRG's focus on the function of this archaeological site was influenced by the theories of

Valter Maestra, an Italian independent researcher and historian of ancient civilizations. He drew a parallel with similar structures found in Malta, which were used to officiate rites of prayer to Mother Earth. According to this hypothesis, the Cividale hypogeum was used in a similar way, to make contact with the esoteric underworld.

This hypothesis was striking and, in parallel with archaeoacoustic research conducted in the South of England and Bosnia-Herzegovina by SBRG. Other researchers had detected the resonance phenomenon in the Maltese underground temples; it was important to test the Cividale structure in the same way.

MATERIALS AND METHODS

Initially, a preliminary study examining every chamber of the hypogeum of Cividale del Friuli with electronic sound generators was carried out following a procedure established by PEAR (Jahn et al. 1995). Once the resonant frequency was identified, the “knots of resonance” provided the optimum position to achieve a resonance effect, which allowed the frequencies to expand in every chamber. After this study, the conditions present in ancient times were recreated using a male or female voice for singing or praying.

SBRG’s recording equipment and microphones were far more dynamic and high-end compared to the equipment used nearly 20 years ago by PEAR (Jahn 1995). The equipment used consisted of dynamic high-end recorders extended in the ultrasound field with a maximum sampling rate of 192KHz (Tascam DR-680) or sampling rate of 96KHz (Tascam DR-100 and Marantz PMD661 equipment).

Microphones with a wide dynamic range and a flat response at different frequencies (Sennheiser MKH 3020, frequency response of 10Hz to 50,000Hz) were used with shielded cables (Mogami Gold Edition XLR) and gold-plated connectors (see Figure 5).

Ultrasensitive omnidirectional microphones

(Aquarian H2a-XLR Hydrophone, frequency response from 10Hz to 100,000Hz) were used to accurately obtain any possible resonance response from the water in the bottom of the chambers. This type of microphone has a wide bandwidth and is used by sea biologists to hear whale song up to several kilometers away. In this case the sound is transmitted very quickly in water, with the body of water acting as a reflector capable of capturing the resonant vibrations (Debertolis and Savolainen 2012).

The correlation between the sound source and response of the chamber through sound spectrum graphics (using computer audio programs) was verified at the same time as the singers voice vibrations were being correlated to the response of the chambers, being analyzed.

Pro Tools version 9.05 software for Mac was used to overlap and mix the various recorded tracks, Praat program version 4.2.1 from the University of Toronto and Audacity open-source program version 2.0.2, both for Windows PC.

Before recording a spectrum analyzer (Spectran NF-3010 from the German factory Aaronia AG) was used to search for electromagnetic phenomena present in the surrounding environment which could potentially have a negative influence on the results.

All recordings were taken several times during the night where the risks of noise from human activity on the surface were lower.

The singers performed a repertoire of ancient chant and overtone singing. It was found that mantras and modulated frequencies excited the surrounding structures at particular frequencies, typical of various mystical songs and prayers.

RESULTS

The experiment took place on various days over a six-month period with different singers used to search for the right resonance phenomena frequency. A few months after SBRG’s research began, the presence of

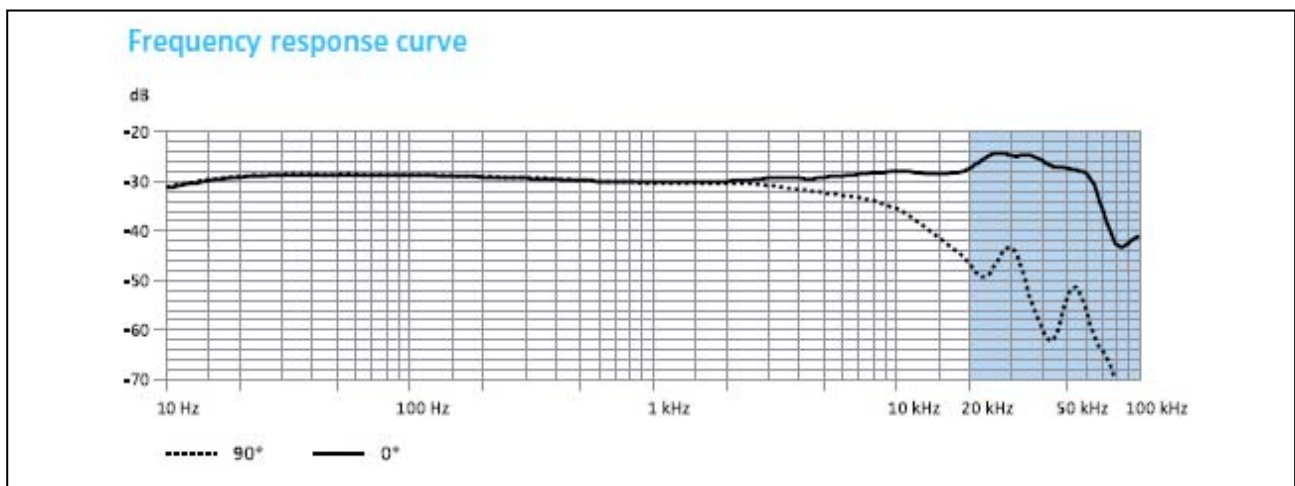


Figure 5. The Extremely Flat Response of Sennheiser MKH 3020 Microphones With a Greater Sensitivity in the Ultrasound Field.



Figure 6. The Entrance to Chamber C Which Seems to Have Retained the Original Shape and Has Demonstrated a Conspicuous Resonant Effect.

the resonance effect in two chambers C and D was detected (see Figures 6-9). These sections retain the original arched shape form along their top. In order to obtain a better response the singers were positioned inside the “sound knots”. A small truss on the end wall in the two chambers seems to have been carved specially to tune up the room for a male voice singing or praying.

The male voice is absolutely necessary to stimulate the resonance phenomenon as the two chambers are tuned to 94Hz and 102Hz. On several occasions, a female voice was used, including a mezzo-soprano voice, however the resonance effect was not reached because below 150Hz it is not possible to stimulate the structure.

The resonance sound response is a range of sound

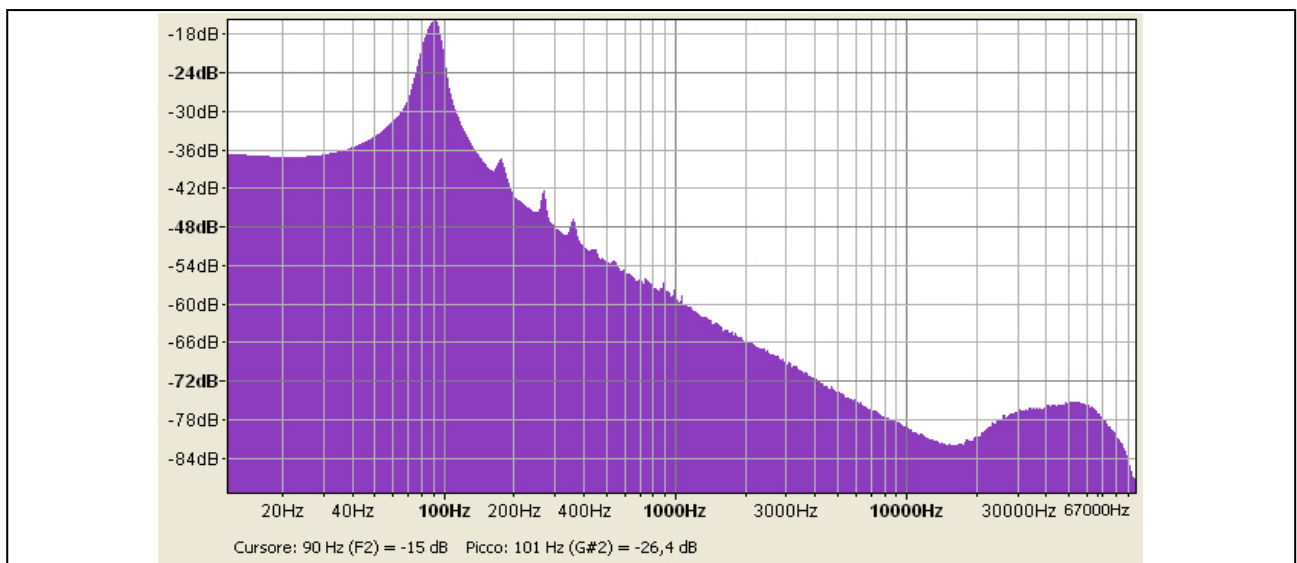


Figure 7. The Logarithmic Plot of the Effect of Resonance in Chamber C.

Notes: The hump between 30KHz and 90KHz is due to increased sensitivity of the Sennheiser microphones at these frequencies, but this is not an anomaly. No ultrasounds have been found in the Cividale del Friuli hypogeum so far.

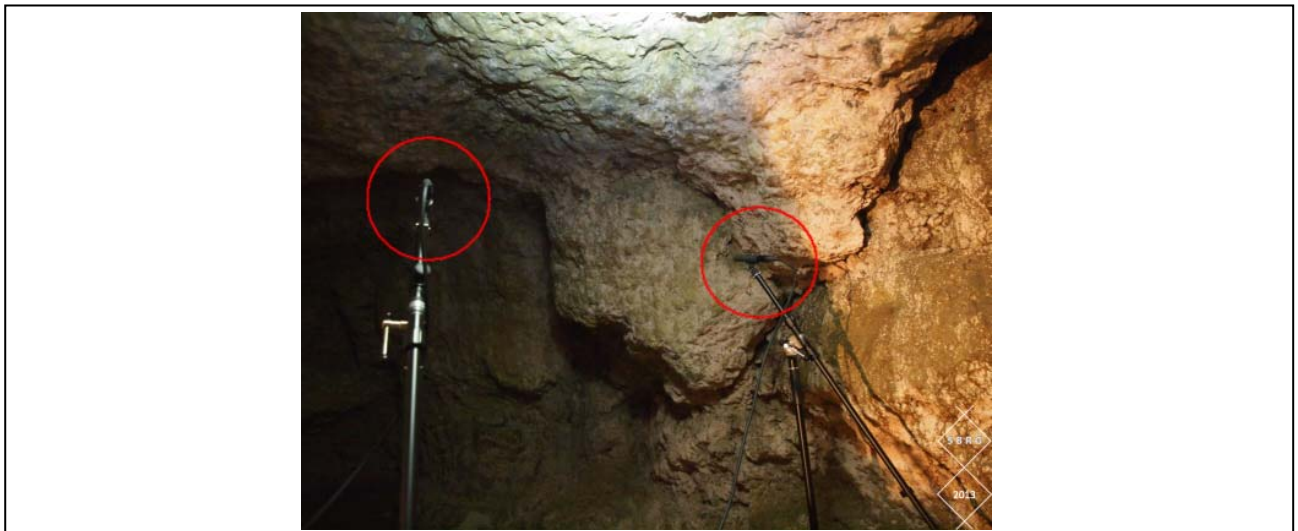


Figure 8. The Un-illuminated Bottom of Chamber D With Microphones Positioned for Recording.

that starts from infrasonic up to the frequency of 102Hz for chamber D or 94Hz for chamber C (the tuning by a male voice to create the resonant effect). This is particularly evident when comparing this graph with the graph of the female voice in which a hole appears in the same range of audible frequencies. Chamber E located below the access stairs had no resonant effect. It is possible that this was dug in a

later period as its shape is completely different from the other rooms along with chamber B (see Figure 10).

DISCUSSION

With a male voice tuned to the right frequency, a response in the infrasound and low frequency bands is

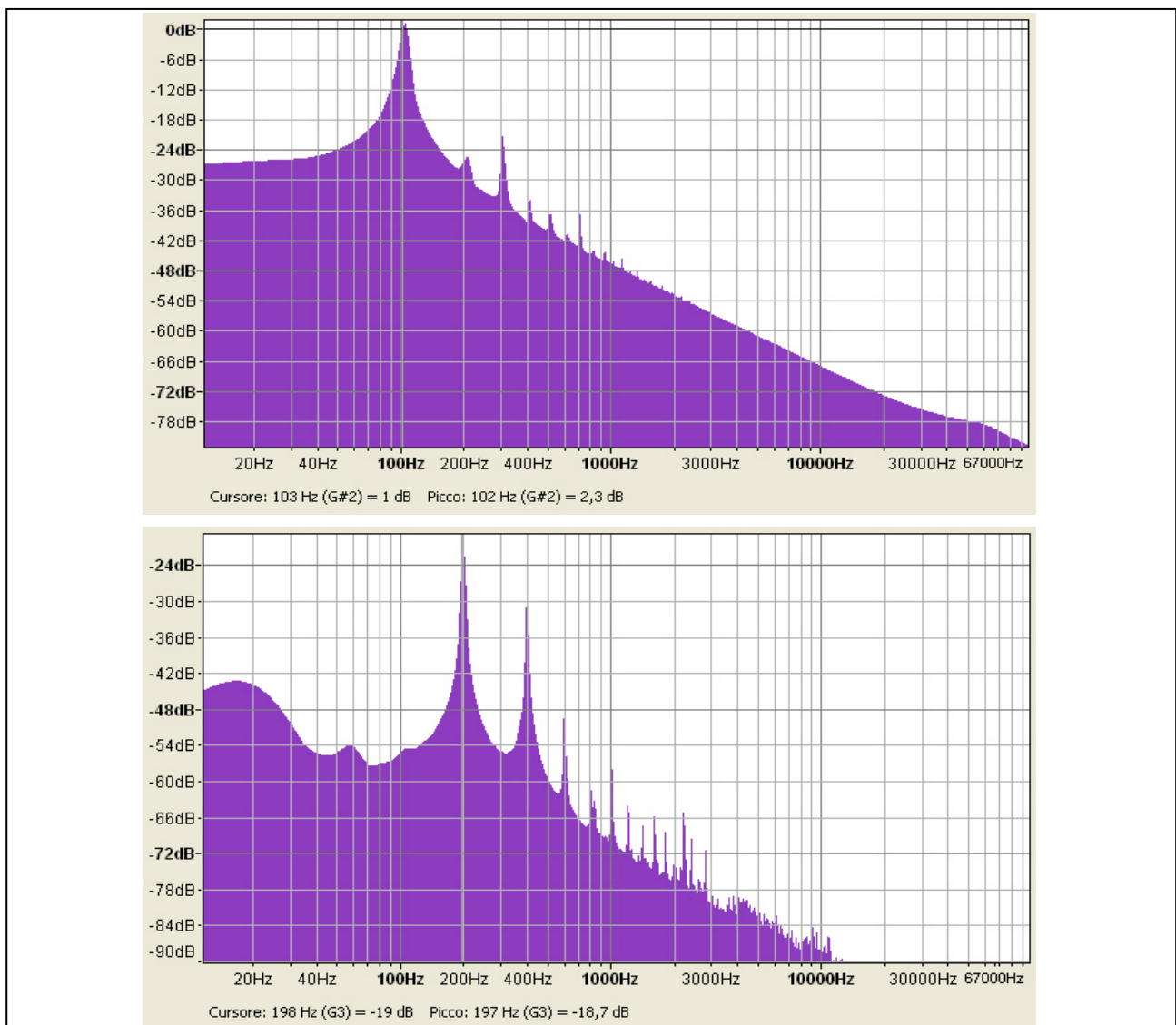


Figure 9. Top: The Harmonious Appearance of the Graph From Chamber D, With a Male Voice Stimulating the Resonance at 102Hz. Bottom: The Detectable Graph of Chamber D With a Female Voice.

Notes: The dominant feature is around 198Hz, the hole in the low frequency range between 20Hz up to 200Hz is clearly shown in the graph.

obtained (see Figure 7). The male voice is reflected back from the structure in a low tone, as happened in the hypogeum of Hal Saflieni, Malta. This is not possible to achieve using a female voice, Figure 7 shows a big hole where any frequencies could be reflected back. The conclusion drawn is that only a male priest could trigger the resonance phenomenon

along with a very low frequency response.

There are many scientific papers that evidence mechanical vibrations can have a positive or negative influence on human health and perception. It is known that the environment contains several sources of naturally occurring very low frequency and infrasounds.



Figure 10. Chamber B of Cividale del Friuli Hypogeum Has a Different Shape to That of Chambers C and D.

Notes: Therefore it is likely that it was modified in later periods or had another purpose. SBRG are also studying if the basin is filled with water, if it is possible to obtain a sound response.

Depending on their age and gender, humans can perceive sounds in the range of 20Hz to 20Khz, and in some cases sounds below 20Hz (which are not audible to the human ear). Careful measurements have shown that hearing does not abruptly stop at 20Hz but the ear is capable of registering infrasound if the sound pressure is sufficient.

Low frequency sound has a relatively long wavelength and low material absorption rate, hence it has the ability to travel vast distances. These properties make it possible to achieve a profound effect on vast tracts of acoustic space with the production of high sound pressure level acoustic waves. Low frequency sound is non-directional in its propagation and therefore has the effect of enveloping the individual without any discernable localized source (Gavreau 1968; as cited in Vinokur 2004).

Some animals such as elephants, hippopotamuses, rhinoceros and giraffes are known to use infrasound to communicate over distances (Langbauer et al. 1991). Many animals are able to perceive infrasonic waves that pass through the earth before natural disasters, which act as an early warning system for them.

Any severe and artificial extreme imposed on the sonic environment has a profoundly destabilizing effect on the human body. Indeed infrasounds have been used in the context of wars and there are several organizations currently conducting research in the area of acoustic weapons, such weapons can confound and reduce the capacity and resistance of concentration in their target when discharged at a sufficiently high volume.

However, natural low vibrations with an absence of high pressure can have a positive influence on human health and some people can perceive very low-frequency sounds as a sensation rather than a sound. Infrasounds may also cause feelings of awe or fear in humans. Given it is not consciously perceived, it may make people feel like odd or supernatural events are taking place (Tandy and Lawrence 1998).

Very low frequency sounds and infrasound vibrations are perceived more by nerve receptors in the bones than by the spiral organ hearing cells. Furthermore this type of sound vibration being non-directional appears to have a substantial effect on the cognitive abilities of the human organism, as

reported in the literature (Tandy and Lawrence 1998).

Unfortunately infrasounds have been long studied primarily as a weapon of the future, but their effect only applies at high volumes. With lower volumes this does not happen, indeed such vibrations can instead strengthen human perceptual abilities (Tandy and Lawrence 1998). This could explain the mystical feeling that some people have when they are in an ambient environment full of these frequencies in deep meditation during a sacred rite, but of course this also happens in other historic “sacred sites” that have the same natural tonal characteristics.

This research was also influenced by the works by Cook, Pajot and Leuchter (2008), who examined the response of the range of resonance phenomenon in ancient temples (95-120Hz) on the human brain. They carried out a pilot project to monitor the brain activity of 30 healthy adults (16 females and 14 males) using an EEG while test subjects listened to tones in the same frequency range. In this study, they were trying to establish if patterns of brain activity changed during a brief exposure to these sounds.

The results were amazing: the activity in the left temporal region was found to be significantly lower, closer to 110Hz than other frequencies. Additionally, the pattern of asymmetric activity over the prefrontal cortex shifted from one of higher activity on the left at most frequencies to right-sided dominance at 110Hz. These findings were compatible with the relative deactivation of language centres and a shift in prefrontal activity that may be related to emotional processing. Achieving this emotional state was an important component of ancient rites so that a real sense of mystical elevation could be obtained (Cook et al. 2008).

CONCLUSIONS

This research demonstrates the effect of archaeoacoustics on the human body, which appears to be an interesting new method for reanalyzing

ancient sites to re-discover a forgotten method that effects the emotional sphere of human consciousness. Modern recording technology is now able to give greater clarity to the origin of many interesting phenomena (Debertolis and Bisconti 2013), reaffirming the aura of legends that pervades some sacred places.

It is clear that the builders of Cividale del Friuli hypogeum wanted to achieve this effect. The similarity with the technology of Hal Saflieni suggests that the construction of the Italian hypogeum could be backdated to the same time period as the Maltese hypogeum. The small truss found on a wall inside two of the chambers which responds to a male singing or praying voice, appears to be an example of knowledge of the physical phenomena of resonance. Its ability to induce mystical states in ancient people using secret rites of Mother Goddess (or other ancient deities) would have been very strong. Could this forgotten process be made use of today to achieve optimum brain states using sound vibrations?

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Note

1. SB Research Group (SBRG) is an international and interdisciplinary project team of researchers (Italian, Croatian, English and Finish members) researching the archaeoacoustics of ancient sites and temples in Europe (www.sbresearchgroup.eu).

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